



# PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

Applicant's or agent's file reference SMC 60510/WO		<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/GB 03/01520	International filing date (day/month/year) 08.04.2003	Priority date (day/month/year) 10.04.2002	
International Patent Classification (IPC) or both national classification and IPC G03G9/08			
Applicant AVECIA LIMITED			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 7 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 6 sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I <input checked="" type="checkbox"/> Basis of the opinion</li> <li>II <input type="checkbox"/> Priority</li> <li>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV <input type="checkbox"/> Lack of unity of invention</li> <li>V <input checked="" type="checkbox"/> Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI <input type="checkbox"/> Certain documents cited</li> <li>VII <input type="checkbox"/> Certain defects in the international application</li> <li>VIII <input type="checkbox"/> Certain observations on the international application</li> </ul>			
Date of submission of the demand  04.09.2003		Date of completion of this report  07.07.2004	
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016		Authorized Officer  Vogt, C  Telephone No. +31 70 340-3706 	

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. **PCT/GB 03/01520**

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

1-21 as originally filed

**Claims, Numbers**

1-55 received on 14.05.2004 with letter of 14.05.2004

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

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**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes: Claims	1-55
	No: Claims	
Inventive step (IS)	Yes: Claims	1-55
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-55
	No: Claims	

**2. Citations and explanations**

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Reference is made to the following documents:

D1: EP-A-962 832

D2: US-A-5 955 235

D3: US-A-6 120 967

2. Claims 1 to 5, 7 to 31 (as they refer back to claim 1):

2.1 Document **D1**, which is considered to represent the most relevant state of the art to the subject-matter of claim 1, discloses (citation: see International Search Report) a toner for developing an electrostatic image comprising toner particles which include a binder resin, a wax and a colorant; with the claimed melting point of the wax; an average circularity of the toner particles is from 0.920 to 0.995; a shape factor SF1 is in the range of 100 to 140; and SF-2 in the range of 100 to 130; and the value of SF2/SF1 is 1.0 or less.

The subject-matter of claim 1 differs from this known toner of D1 in the specific value of the wax domain size in the toner; in the shape factor SF1 and furthermore in the specific ratio of SF1/SF2.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

2.2 The problem to be solved by the present invention may be regarded as providing a toner having improved transfer efficiency and improved cleaning properties.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: The Applicant has provided comparative examples which show ( Ex.4 and 7, table 1) an increase in cleaning properties of a toner comprising a specific value of SF1 (non-spherical) and furthermore a specific value of the ratio of SF1/SF2 according to present claim 1 (see Ex. 1, to 3, 5 and 6) compared to an otherwise identical carrier with a different SF1-value, a different ratio of SF1/SF2 and a specific domain size value. It is not rendered obvious from D1 alone or in combination with other available document - such as D2 which discloses a toner comprising the wax in the claimed domain size, but is silent about average circularity, SF1, SF2 and the ratio of SF1/SF2 - to replace said wax component according to claim 1 and further modify said toner particles according to claim 1 to provide a toner solving the problem posed. The applicant has shown an unexpected effect over the toner in D1.

Thus, the subject-matter of claim 1 involves an inventive step (Article 33(3) PCT).

2.3 Claims 2 to 5, 7 to 31 -as they refer back to claim 1 - are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

3. Claims 6, 7 to 31 (as they refer back to claim 6):

2.1 Document D1, which is considered to represent the most relevant state of the art to the subject-matter of claim 6, discloses (citation: see International Search Report) a toner for developing an electrostatic image comprising toner particles which include a binder resin, a wax and a colorant; with the claimed melting point of the wax; an average circularity of the toner particles from 0.920 to 0.995; a shape factor SF-1 in the range of 100 to 140; and also a ratio of  $SF2/SF1 = 1.0$  or less (i.e.  $SF1 > SF2$ , see page 7, paragraph 0052)

The subject-matter of claim 6 differs from this known toner of D1 in the specific value of the wax domain size in the toner and furthermore in the specific narrower value of SF1. The subject-matter of claim 6 is therefore new (Article 33(2) PCT).

3.2 The problem to be solved by the present invention may be regarded as providing a toner having improved transfer efficiency and improved cleaning properties.

The solution to this problem proposed in claim 6 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: The Applicant has provided comparative examples which show ( Ex.4 and 7, table 1) an increase in cleaning properties of a toner comprising a specific SF value (non spherical) according to present claim 6 (see Ex. 1, to 3, 5 and 6) compared to an otherwise identical toner with a different of SF1 and a specific domain size value.

It is not rendered obvious from D1 alone or in combination with other available document - such as D2 to replace the wax component by a wax according to claim 6 and furthermore to modify said toner particles according to claim 6 to provide a toner solving the problem posed. The applicant has shown an unexpected effect over the toner in D1.

Thus, the subject-matter of claim 6 involves an inventive step (Article 33(3) PCT).

3.3 Claims 7 to 31 -as they refer back to claim 6 - are dependent on claim 6 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

**4. Claims 32 to 34:**

The subject-matter of independent process-claim 32 and its dependent claims 33 and 34 is characterized by the new and inventive subject-matter of claims 1 and 6. Consequently, claims 32 to 34 also meet the requirements of the PCT with respect to novelty and inventive step.

**5. Claims 35 to 54:**

5.1 Document **D3**, which is considered to represent the most relevant state of the art to the subject-matter of claim 35, discloses (citation: see International Search Report) a process for the manufacture of a toner for developing an electrostatic image comprising toner particles which include a binder resin, a wax - providing the claimed melting point - and a colorant with a shape factor of the toner particles of 125, comprising the process steps of:

i) providing a latex dispersion, ii) a wax dispersion, iii) and a colorant dispersion, iv) mixing the latex-, the wax- and the colorant dispersions and v) causing the mixture to aggregate (flocculate).

The subject-matter of claim 35 differs from this known process of D3 in that the latex dispersion has at least one latex with a monomodal molecular weight distribution and at least one latex with a bimodal molecular weight distribution.

The subject-matter of claim 35 is therefore new (Article 33(2) PCT).

5.2 The problem to be solved by the present invention may be regarded as providing a process for the manufacturing of a toner having improved release properties.

The solution to this problem proposed in claim 35 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: It is not rendered obvious from D3 alone or in combination with other available document to replace the latex dispersion by a latex dispersion which has at least one latex with a monomodal molecular weight distribution and at least one latex with a bimodal molecular weight distribution according to claim 35 to provide a toner solving the problem posed.

Thus, the subject-matter of claim 35 involves an inventive step (Article 33(3) PCT).

5.3 Claims 36 to 53 are dependent on claim 35 and as such also meet the

requirements of the PCT with respect to novelty and inventive step.

**6. Claim 55:**

6.1 Document **D1**, which is considered to represent the most relevant state of the art to the subject-matter of claim 55, discloses (citation: see International Search Report) a toner for developing an electrostatic image comprising toner particles which include a binder resin, a wax and a colorant; with the claimed melting point of the wax; an average circularity of the toner particles is from 0.920 to 0.995; a shape factor SF-1 is in the range of 100 to 140; and SF-2 in the range of 100 to 130; and the value of SF-2/SF-1 is 1.0 or less.

The subject-matter of claim 55 differs from this known toner of D1 in the specific value of the wax domain size in the toner and furthermore in the molecular weight distribution of the resin.

The subject-matter of claim 55 is therefore new (Article 33(2) PCT) in view of the available prior art.

6.2 The problem to be solved by the present invention may be regarded as providing a toner having improved release properties.

The solution to this problem proposed in claim 55 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: It is not rendered obvious from D1 alone or in combination with other available document to replace the toner binder resin by a binder resin with the specific molecular weight distribution according to claim 55 to provide a toner solving the problem posed. Thus, the subject-matter of claim 55 involves an inventive step (Article 33(3) PCT) in view of the available prior art.

Claims

1. A toner for developing an electrostatic image comprising toner particles which include a binder resin, a wax and a colorant, wherein the wax has a melting point of between 50 and 150°C, the wax exists in the toner particles in domains of 2 µm or less mean particle size and:

(a) the mean circularity of the toner particles as measured by a Flow Particle Image Analyser is at least 0.90; and

(b) the shape factor, SF1, of the toner particles is at most 165.

2. A toner according to Claim 1 wherein the mean circularity of the toner particles is in the range from 0.93 to 0.99.

3. A toner according to Claim 2 wherein the mean circularity of the toner particles is in the range from 0.94 to 0.96.

4. A toner according to any one of Claims 1 or 3 wherein SF1 of the toner particles is in the range from 105 to 155.

5. A toner according to Claim 4 wherein SF1 of the toner particles is at most 145.

6. A toner according to Claim 4 wherein SF1 of the toner particles is in the range from 130 to 150.

7. A toner according to Claim 6 wherein SF1 of the toner particles is in the range from 135 to 145.

8. A toner according to any one of the preceding Claims wherein the shape factor, SF2, of the toner particles is in the range from 105 to 155.

9. A toner according to Claim 8 wherein SF2 of the toner particles is at most 145.

10. A toner according to Claim 9 wherein SF2 of the toner particles is in the range from 120 to 140.

11. A toner according to Claim 10 wherein SF2 of the toner particles is in the range from 125 to 135.

12. A toner according to any one of the preceding Claims wherein the BET surface area of the toner particles before any optional blending with surface additives is 0.5-2.0



m<sup>2</sup>/g.

13. A toner according to Claim 12 wherein the BET surface area of the particles is 0.6-1.3 m<sup>2</sup>/g.

14. A toner according to Claim 13 wherein the BET surface area of the particles is 0.7-1.1 m<sup>2</sup>/g.

15. A toner according to Claim 14 wherein the BET surface area of the particles is 0.9-1.0 m<sup>2</sup>/g

16. A toner according to any one of the preceding Claims wherein the binder resin has a ratio of weight average molecular weight (Mw) to number average molecular weight (Mn) of at least 3.

17. A toner according to Claim 16 wherein the ratio Mw/Mn is at least 5.

18. A toner according to Claim 17 wherein the ratio Mw/Mn is at least 10.

19. A toner according to any one of the preceding Claims wherein the wax exists in the toner in domains of mean diameter 1.5µm or less.

20. A toner according to any one of the preceding Claims wherein the binder resin is prepared from at least one latex containing a resin having a monomodal molecular weight distribution and at least one latex containing a resin having a bimodal molecular weight distribution.

21. A toner according to Claim 20 wherein the monomodal molecular weight resin is a low molecular weight resin and has a number average molecular weight of from 3000 to 10000.

22. A toner according to Claim 21 wherein the monomodal molecular weight resin has a number average molecular weight of from 3000 to 6000.

23. A toner according to any of Claims 20-22 wherein the bimodal resin has a weight average molecular weight of from 100,000 to 500,000.

24. A toner according to Claim 23 wherein the bimodal resin has a weight average molecular weight of from 200,000 to 400,000.

25. A toner according to any one of the preceding Claims wherein the resin comprises a copolymer of (i) a styrene or substituted styrene, (ii) at least one alkyl acrylate or methacrylate and (iii) an hydroxy-functional acrylate or methacrylate.

26. A toner according to any one of the preceding Claims wherein the wax has a melting point of from 50 to 130°C.

27. A toner according to claim 26 wherein the wax has a melting point of from 50 to 110 °C.

28. A toner according to claim 27 wherein the wax has a melting point of from 65 to 85 °C.

29. A toner according to any one of the preceding Claims wherein the wax comprises a wax selected from the group consisting of: a polyethylene wax, a paraffin wax, a Fischer-Tropsch wax and an ester wax, including Carnauba wax.

30. A toner according to any one of the preceding Claims wherein the amount of wax incorporated in the toner is from 1 to 30 wt% based on the total weight of toner.

31. A toner according to Claim 30 wherein the amount of wax is from 3 to 20 wt%.

32. A toner according to Claim 31 wherein the amount of wax is from 5 to 15 wt%.

33. A toner according to any of the preceding Claims which further comprises a charge control agent.

34. A process for forming an image, the process comprising developing an electrostatic image using a toner according to any one of the preceding claims, wherein the haze at a print density of 1.0 mg/cm<sup>2</sup> is below 40, and the ratio of the values at fusion temperatures of 130 and 160°C is at most 1.5.

35. A process for forming an image according to Claim 34 wherein the ratio of haze values is at most 1.3.

36. A process for forming an image according to Claim 35 wherein the ratio of haze values is at most 1.2.

37. A process for the manufacture of a toner according to any one of the preceding claims 1 to 33 which comprises the following steps:

I. providing a latex dispersion;

- II. providing a wax dispersion;
- III. providing a colorant dispersion
- IV. mixing the latex dispersion, wax dispersion and colorant dispersion; and
- V. causing the mixture to flocculate.

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38. A process according to Claim 37 wherein the latex dispersion comprises an ionic surfactant.

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39. A process according to Claim 37 or claim 38 wherein the preparation of the latex dispersion comprises mixing together at least one latex containing a resin having a monomodal molecular weight distribution and at least one latex containing a resin having a bimodal molecular weight distribution.

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40. A process according to claim 39 wherein the latex containing a resin having a bimodal molecular weight distribution is prepared by a process comprising the successive steps of forming a polymer of high molecular weight distribution followed by forming a polymer of low molecular weight distribution such that the resulting latex comprises composite particles comprising both said low molecular weight polymer and said high molecular weight polymer.

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41. A process according to any one of Claims 37 to 40 which, prior to step iv, further comprises the step of providing a charge control agent dispersion, which dispersion is then incorporated in step iv by mixing.

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42. A process according to claim 41 wherein the charge control agent is milled with the colorant.

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43. A process according to any one of claims 37 to 42 wherein the preparation of the wax dispersion comprises the mixing together of the wax with an ionic surfactant.

44. A process according to any of claims 37 to 43 wherein the preparation of the colorant dispersion comprises the milling together of the colorant with an ionic surfactant.

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45. A process according to claims 38, 43 and 44 wherein the dispersions of latex, colorant, wax, and charge control agent where present, have the same sign charge on the surfactant.

46. A process according to claim 45 wherein the surfactant present in the dispersions contains a group which can be converted from an ionic to a non-ionic form and vice versa

by adjustment of pH.

47. A process according to claim 46 wherein the surfactant contains a carboxylic acid group and the dispersions are mixed in step (iv) at neutral to high pH and the flocculation step (v) is then effected by reduction of pH.

48. A process according to claim 46 wherein the surfactant contains a tertiary amine group and the dispersions are mixed in step (iv) at neutral to low pH and the flocculation step (v) is then effected by increase of pH.

49. A process according to any of claims 37 to 48 further comprising heating the flocculated mixture obtained after step (v) to form loose aggregates of particle size from 3 to 20  $\mu\text{m}$ .

50. A process according to claim 49 further comprising heating the aggregates to a temperature above the  $T_g$  of the latex to induce coalescence to form toner particles.

51. A process according to claim 50 further comprising blending the particles with one or more surface additives.

52. A process according to claim 51 wherein the surface additives comprise one of the following: (i) hydrophobised silica ; (ii) large and small particle size silica which may optionally be hydrophobised (iii) hydrophobised silica and one or both of hydrophobised titania and hydrophilic or hydrophobised alumina ; (iv) large and small particle size silica and one or both of hydrophobised titania and hydrophilic or hydrophobised alumina.

53. A process for the manufacture of an electrophotographic apparatus and/or a component of the apparatus and/or a consumable for use with the apparatus, the process using a toner as claimed in any of claims 1 to 33.

54. An electrophotographic apparatus, a component of the apparatus and/or a consumable for use with the apparatus, which comprises a toner as claimed in any of claims 1 to 33.

55. An electrophotographic apparatus according to claim 54 which has one or more of the following:

- i) a developer roller and metering blade ;
- ii) a cleaning device for mechanically removing waste toner from a photoconductor ;

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- iii) a photoconductor that is charged by a contact charging means;
- iv) a contact development member;
- v) oil-less fusion rollers; and/or
- vi) is a four colour printer or copier, including a tandem machine.